

## SECTION IV.—RIVERS AND FLOODS.

## RIVERS AND FLOODS, JUNE, 1916.

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[Dated: River and Flood Division, Weather Bureau, July 31, 1916.]

Local floods occurred on the 1st, in northeastern Iowa, due to torrential rains which fell in connection with Low No. I, Chart III. The following account of the rainstorm and the resulting floods has been prepared by Meteorologist J. H. Spencer, in charge of the Dubuque (Iowa) river district:

The storm in northeast Iowa on June 1, 1916, was one of the most destructive on record in this part of the country, owing to the resulting local floods. Exceptionally heavy rainfall was recorded over the greater part of northeast Iowa, in connection with severe thunderstorms. These storms occurred between 5 p. m. and midnight, and most of the rain fell in less than three hours. At Decorah, Iowa, the amount of rainfall was 3.21 inches, and the time of heaviest fall between 5:30 p. m. and 7 p. m. At Prairie du Chien, Wis., the amount was 4.10 inches, and the time 6 p. m. to 9:30 p. m.

The result of such heavy rainfall in such a short period was that in the more hilly sections of northeast Iowa floods of an exceptionally destructive character occurred. A great volume of water rushed down the steep hillsides into creeks or small rivers, sweeping away bridges, buildings, live stock, etc.

The greatest losses were at Decorah, Fort Atchison, and McGregor, all Iowa towns, but there was hardly a railroad line in northeast Iowa that did not experience damage of some sort. More than 25 large railroad bridges and a large number of county bridges and culverts were damaged or destroyed. The water rushed through the principal street of McGregor, flooding stores and doing great damage.

At Packard, Iowa, a passenger train ran into a washout and 16 persons were killed and many injured.

Damage was so severe to railroad property that normal traffic on some of the branch lines of northeast Iowa was not resumed for six weeks or more. It will, in fact, require many months to complete permanent repairs.

Losses are estimated to be at least \$500,000, divided as follows: \$250,000 to railroads, roadbed and track, rolling stock and contents, etc.; \$150,000 to the various counties visited by the storm—bridges and culverts, chiefly; \$100,000 to private individuals—stocks of merchandise, live stock, suspension of business and wages of employees, etc.

Other severe local floods occurred in the watershed of the Chemung and Canisteo rivers of south-central New York and in north-central counties of Pennsylvania. The rains which produced these floods fell on the 16th and 17th, but inasmuch as there is no regular Weather Bureau station in that region, the rainfall was not shown on the daily weather maps; it must have fallen in connection with Low No. VII of Chart III. Two weeks later heavy rains again visited this region, destroying much of the construction work that had been begun to restore the property damaged by the floods of two weeks previous. Newspaper reports of damage in the Chemung and Canisteo Valleys, also in Potter and Tioga Counties, Pa., place the loss at \$375,000. Four persons lost their lives by drowning. As an instance of the heavy local downpours, it is stated that Lake Keuka, of Yates and Steuben Counties in central New York, with a drainage area of about 196 square miles, on June 17 rose 7 inches in 24 hours. The lake itself has an area of approximately 29 square miles. A rise of 7 inches would therefore represent a little more than 413,000,000 cubic feet, or about one-third of a cubic mile of water.

*Floods on the Neosho in southeast Kansas.*—The Neosho was in flood throughout its entire course in Kansas during the month. In duration the flood was one of the longest on record. Heavy rains fell on the 5th, 6th, and again on the 10th. The fall on the last-named date at five stations in the valley averaged exactly 3 inches, and it was to this sudden downpour, for it all came during the night of June 10-11, that caused the general overflow and the subsequent high water.

While the heaviest losers were the owners of inundated farms with growing crops, the most severe sufferers were the occupants of houses bordering Rock and Elm Creeks, tributary to the Neosho River, in Allen County. The flood water stood at a depth of several feet in many houses, damaging household goods and other property. Crude oil was carried from the adjoining oil fields by the flood, and when the water receded the petroleum was deposited along with silt in houses, on lawns, streets, and farm lands. In the vicinity of Humboldt and Chanute oil and gas operations in the bottom lands were suspended for two weeks. Drillers were unable to work, and pumping plants were forced to shut down. Other losses to the oil industry were caused by the breaking of two pipe lines across the river, cutting off the production from market.

Most of the levees breached by the flood of last September were broken again. On account of washed-out tracks and bridges, passenger traffic on the Missouri, Kansas & Texas and the Missouri Pacific Railways was suspended for several days.

At Emporia, near the confluence of the Cottonwood and Neosho Rivers, the flood stage was exceeded on June 1, which was a continuation of the overflow of May 31. The flood stage was also exceeded on June 8-9, June 12-18, inclusive, and June 21-24, inclusive, making 14 days of inundation of lowlands in that vicinity. The highest stage, 23.5 feet, occurred on June 14 and 15. The greatest loss in that vicinity was the inundation of prospective crops.

At Iola the flood stage was exceeded on 15 days from June 11 to 23, inclusive, and again on June 25-26. The highest water, 4.5 feet above flood stage on June 11, lacked two-tenths of the maximum stage on September 7, 1915, and seven-tenths of a foot of the highest stage recorded at this station on July 10, 1904, the latter being the most extensive flood for which there are reliable records. During June, 1916, the inundation of lowlands for 15 days was 3 days more prolonged but was probably not quite so extensive as during July, 1904. In this part of the river course more than half of the overflowed crops were a total loss, although some of the land will be planted again this season.

The estimated losses due to the floods of the Neosho River and its tributaries during June, 1916, were:

Buildings, factories, municipal plants, highways, bridges.....	\$20, 500
Crops which may or may not have been housed.....	352, 000
Prospective crops, 94,650 acres involved.....	946, 500
Live stock or other movable property.....	10, 500
Suspension of business, including wages of employees.....	70, 000

Warnings of the flood were generally issued from 18 to 48 hours in advance of the overflow. On several days previous to the flood notices were given to daily newspapers and published that with the river nearly bank-full, heavy rains would cause destructive overflow of lowlands along the river course.—H. K. Holcomb, Observer.

*Flood in Mississippi.*—Following the flood of April 14 to June 2, another flood occurred in the Mississippi River from below Warsaw, Ill., to Louisiana, Mo., from June 7 to about June 26, 1916.

At Quincy, Ill., the river was at or above the flood stage from June 7 to 22 and the highest was 16.4 feet on June 9 and 10.

At Hannibal, from June 7 to June 26, the highest was 16.9 feet, June 10.

At Louisiana, from June 7 to June 24, the highest was 15.8 feet on June 10.

Advisory warnings were issued on June 6 and flood warnings on June 7 and 8.

Following as it did the long-continued flood of April, May, and early June, this flood caused but little actual damage. No property was destroyed, the damage consisting of a further delay in the planting and cultivation of crops in the bottom lands. The flood continued so late that it was the first of July before the unprotected lands could be plowed, and as a result thousands of acres of this land will grow up in weeds, which would have been planted in corn, had the water receded two weeks earlier.—E. L. Waldron, Meteorologist.

*Floods in the Arkansas River.*—Heavy local downpours on the 5th, Low No. III, Chart III, in the vicinity of Wichita, Kans., caused Chisholm Creek, a tributary of the Arkansas, which passes through Wichita before joining the main stream, to overflow its banks in the northern part of the city, where large areas in the stock yards and adjoining sections were inundated. The situation became critical later in the day, because of a rise that came down the Little Arkansas River, which

joins the main stream a few miles above the city of Wichita. Levees, which had been erected in 1904 as a protection from overflow from the Little Arkansas, held and serious financial loss was averted. The total acreage overflowed from both rivers was about 2,800 and the damage \$38,180.

Heavy rainfalls again on the 20th, in connection with low No. VIII, Chart III, caused the overflow of about 300 acres in the sparsely settled districts in the north end of Wichita, and probably 3,000 acres in rural districts, damaging crops to the extent of about \$30,000. The total loss in the Wichita district is estimated at \$68,180.

*The Columbia River flood.*—The Columbia River rose steadily from the melting snow in the mountains. Backwater from this stream caused the Willamette River, at Portland, to rise from 14.5 feet on the 1st to 22.7 feet on the 30th, and it was still rising at the latter date. Heretofore the latest date the crest of the Columbia River flow reached Portland was July 1-2, in 1880, while this year the crest will not be reached until even later than in 1880.—*E. A. Beals, District Forecaster.*

The total loss or damage by floods during June, 1916, as enumerated above is \$2,642,680.

Loss to railroads in Arkansas during January-February, 1916, not previously reported, \$35,941.51.

The usual statistics of floods in the principal rivers and their tributaries follow in six tables.

TABLE 1.—Floods in the upper Mississippi and tributaries during June, 1916.

River.	Station.	Flood stage.	Above flood stage.		Crest.	
			From—	To—	Stage.	Date.
		<i>Fect.</i>			<i>Fect.</i>	
Mississippi.....	Keokuk, Iowa.....	14.0	7	14	14.2	8-12
Do.....	Warsaw, Ill.....	17.0	7	12	17.0	7-12
Do.....	Hannibal, Mo.....	13.0	1	3	13.6	1
Do.....	do.....	13.0	7	26	16.9	10
Do.....	Louisiana, Mo.....	12.0	1	2	13.0	1
Do.....	do.....	12.0	7	24	15.8	10
Do.....	Quincy, Ill.....	14.0	7	22	16.4	9-10
Do.....	Grafton, Ill.....	18.0	1	3	20.7	1
Do.....	do.....	18.0	9	18	20.0	11-12
Do.....	St. Louis, Mo.....	30.0	2	2	29.9	1
Do.....	Cape Girardeau, Mo.....	30.0	2	2	30.1	1
St. Croix.....	Stillwater, Minn.....	11.3	1	9	13.5	1-2
Illinois.....	La Salle, Ill.....	18.0	1	5	18.7	3
Do.....	do.....	18.0	8	30	21.4	11, 24
Do.....	Peoria, Ill.....	16.0	11	30	17.4	25-26
Do.....	Beardstown, Ill.....	12.0	1	30	14.4	1

TABLE 2.—Floods in the Missouri River and tributaries during June, 1916.

River.	Station.	Flood stage.	Above flood stage.		Crest.	
			From—	To—	Stage.	Date.
		<i>Fect.</i>			<i>Fect.</i>	
Missouri.....	Blair, Nebr.....	15.0	.....	.....	14.5	30
Do.....	Hermann, Mo.....	21.0	8	9	21.1	9
Solomon.....	Beloit, Kans.....	16.0	.....	.....	15.6	15, 21
Smoky Hill.....	Lindsborg, Kans.....	20.0	14	14	21.5	14
Grand.....	Chillicothe, Mo.....	18.0	4	4	18.2	4
Do.....	do.....	18.0	7	10	25.6	8
Do.....	do.....	18.0	26	26	19.8	26
Osgood.....	Osgood, Mo.....	20.0	16	18	22.0	16
Do.....	Bagnell, Mo.....	20.0	.....	.....	19.8	8

TABLE 3.—Floods in the upper Arkansas River and tributaries during June, 1916.

River.	Station.	Flood stage.	Above flood stage.		Crest.	
			From—	To—	Stage.	Date.
		<i>Fect.</i>			<i>Fect.</i>	
Arkansas.....	Wichita, Kans.....	4.0	7	7	4.6	7
Do.....	do.....	4.0	31	22	5.1	21
Cottonwood.....	Emporia, Kans.....	19.5	1	1	20.7	1
Do.....	do.....	19.5	8	9	20.0	9
Do.....	do.....	19.5	12	13	23.5	14, 15
Do.....	do.....	19.5	21	24	22.6	22
Neosho.....	Neosho Rapids, Kans.....	22.0	16	16	22.0	16
Do.....	do.....	22.0	22	23	22.9	22
Do.....	Le Roy, Kans.....	24.0	12	21	27.1	12
Do.....	do.....	24.0	24	25	24.5	24
Do.....	Iola, Kans.....	10.0	11	23	14.5	11
Do.....	do.....	10.0	25	26	11.0	26
Do.....	Oswego, Kans.....	20.0	13	28	23.1	19
Grand.....	Fort Gibson, Okla.....	22.0	15	15	22.0	15
North Canadian.....	Reno Junction, Okla.....	8.0	10	15	13.6	10
Do.....	do.....	8.0	13	18	8.1	18

TABLE 4.—Floods in the Susquehanna River and tributaries during June, 1916.

River.	Station.	Flood stage.	Above flood stage.		Crest.	
			From—	To—	Stage.	Date.
		<i>Fect.</i>			<i>Fect.</i>	
Susquehanna.....	Williamsport, Pa.....	20.0	17	17	21.0	17
Chemung.....	Corning, N. Y.....	16.0	17	17	18.4	17
Pine Creek.....	Waterville, Pa.....	12.0	17	17	14.0	17
Juniata.....	Huntingdon, Pa.....	14.0	17	17	14.8	17

TABLE 5.—Floods in the Southern States during June, 1916.

River.	Station.	Flood stage.	Above flood stage.		Crest.	
			From—	To—	Stage.	Date.
		<i>Fect.</i>			<i>Fect.</i>	
Staunton.....	Randolph, Va.....	21.0	16	16	21.4	16
Roanoke.....	Weldon, N. C.....	30.0	17	18	36.7	17
Santee.....	Rimini, S. C.....	12.0	18	22	12.7	19
Do.....	Ferguson, S. C.....	12.0	20	23	12.4	21, 22
Cape Fear.....	Elizabethtown, N. C.....	20.0	9	10	23.6	10
Do.....	do.....	20.0	19	19	20.7	19
West Pearl.....	Pearl River, La.....	13.0	1	1	13.3	1
Trinity.....	Liberty, Tex.....	25.0	1	2	26.4	1
Rio Grande.....	San Marcial, N. Mex.....	11.0	1	30	13.0	16

TABLE 6.—Floods in the rivers of the Pacific slope during June, 1916.

River.	Station.	Flood stage.	Above flood stage.		Crest.	
			From—	To—	Stage.	Date.
		<i>Fect.</i>			<i>Fect.</i>	
Columbia.....	Marcus, Wash.....	24.0	14	(1)	33.8	30
Do.....	Wenatchee, Wash.....	40.0	22	(1)	46.4	30
Do.....	The Dalles, Ore.....	40.0	.....	.....	39.9	30
Do.....	Vancouver, Wash.....	15.0	7	(1)	23.6	30
Kootenai.....	Bonners Ferry, Idaho.....	26.0	17	(1)	32.7	22
Pend Oreille.....	Newport, Wash.....	16.0	19	(1)	21.8	30
Clearwater.....	Kamiah, Idaho.....	12.0	16	20	13.7	19
Willamette.....	Portland, Ore.....	15.0	8	(1)	22.7	30
San Joaquin.....	Firebaugh, Cal.....	12.0	15	23	12.4	19, 20
Kings.....	Piedra, Cal.....	12.0	6	19	13.1	17
Colorado.....	Topock, Ariz.....	14.0	18	23	14.8	20
Green.....	Green River, Wyo.....	9.0	18	24	10.0	22
Gunnison.....	Sapinero, Colo.....	16.0	4	22	17.4	14

<sup>1</sup> Flood stage continued into July.